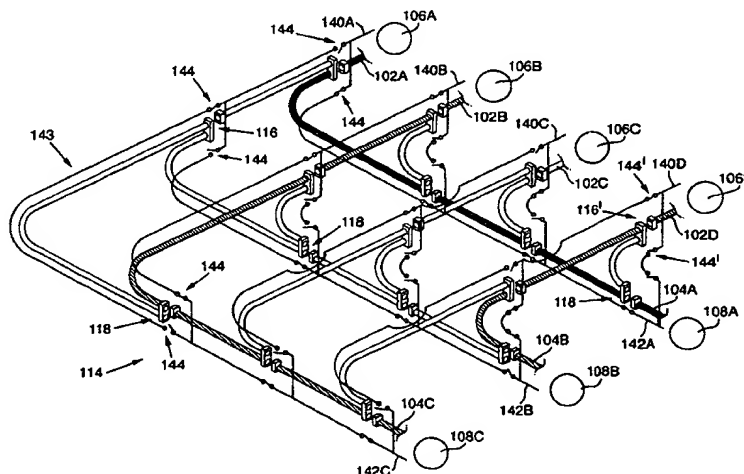




INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

| | | | |
|---|--|-----------|---|
| (51) International Patent Classification ⁶ : A24C 5/32 | | A1 | (11) International Publication Number: WO 99/22611 |
| | | | (43) International Publication Date: 14 May 1999 (14.05.99) |
| (21) International Application Number: PCT/GB98/03276 | | | (81) Designated States: CN, JP, US, European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE). Published <i>With international search report. Before the expiration of the time limit for amending the claims and to be republished in the event of the receipt of amendments.</i> |
| (22) International Filing Date: 3 November 1998 (03.11.98) | | | |
| (30) Priority Data: 9723297.9 4 November 1997 (04.11.97) GB 9821865.4 7 October 1998 (07.10.98) GB | | | |
| (71) Applicant (for all designated States except US): MOLINS PLC [GB/GB]; 11 Tanners Drive, Blakelands, Milton Keynes MK14 5LU (GB). | | | |
| (72) Inventors; and (75) Inventors/Applicants (for US only): MAGNUSON, Richard, Edmond [US/US]; 3900 Carolina Avenue, P.O. Box 16008, Richmond, VA 23222 (US). MEADE, Paul, Malcolm [GB/US]; 3900 Carolina Avenue, P.O. Box 16008, Richmond, VA 23222 (US). PRUESSMANN, Dirk [DE/US]; 3900 Carolina Avenue, P.O. Box 16008, Richmond, VA 23222 (US). THEURER, Philip, Neil [US/US]; 3900 Carolina Avenue, P.O. Box 16008, Richmond, VA 23222 (US). | | | |
| (74) Agents: WEBB, John, Charles et al.; Molins plc, Group Patent Dept., Haw Lane, Saunderton, High Wycombe, Bucks HP14 4JE (GB). | | | |

(54) Title: CONVEYING ROD-LIKE ARTICLES PNEUMATICALLY



(57) Abstract

A conveying system for pneumatic conveyance of cigarette filter rods provides a matrix (114) of pneumatic conveying tubes (102, 104) and switches (116, 118) allowing filters to be delivered from any of a number of distributors (106) associated with different cigarette filter making machines to any of a number of receivers (108) at different cigarette filter assembling machines. The system includes pneumatic switches (116, 118) for selectively connecting pneumatic tubes at each junction, and corresponding commonly-switched electrical switches (144) for establishing electrical communication in accordance with the pneumatic connections. The pneumatic and electrical switching means may comprise a rotary or linear reciprocable switch element. In another system for transferring cigarette filter rods between groups of delivery devices and groups of receiving devices, pneumatic switches (64) are used to allow switching of rods from one group of delivery devices to another to supplement supply when required. A path length determination for rods conveyed pneumatically through a series of tubes may be made by detection of a sound pulse transmitted along the path of the rods through the tubes.

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Conveying Rod-Like Articles Pneumatically

This invention relates to systems for conveying rod-like articles pneumatically. Such systems are commonly used in the tobacco industry to convey filter rod lengths from a filter rod making machine (or a filter rod reservoir associated with such a machine) to a filter cigarette assembling machine, at which the filter rod lengths are cut and combined with wrapped tobacco lengths to form filter cigarettes. It is known to provide pneumatic distribution systems where a plurality of filter rod making machines are pneumatically linked for conveyance of filter rods to a plurality of filter cigarette assembling machines. In such systems electrical communication lines extend between the pneumatically linked machines, so as to allow control signals relating to the conveyance of filter rods to pass between the machines.

According to a first aspect of the invention a pneumatic conveying system for rod-like articles comprises at least one delivery device, at least one receiving device, means defining a pneumatic delivery path extending from said delivery device, means defining a pneumatic receiving path extending towards said receiving device, first switch means for selectively establishing connection between said delivery path and said receiving path, means for establishing communication between said delivery device and said receiving device including second switch means for selectively enabling signal communication in accordance with the status of said first switch means, and means for switching said first and second switch means. The first and second switch means may include a common switching element. Preferably said second switch means is associated with electrical communication lines extending between said delivery device and said receiving device. The electrical communication lines may include processing means such as a microprocessor. Preferably the system includes a control means for actuating said switching element in accordance with signals derived in dependence on occupation or passage of articles in the system. In a preferred arrangement there are a plurality of delivery and receiving devices and the paths and communication lines, together with the appropriate switches, allow any of the delivery devices to transmit articles to any of the receiving devices.

According to a second aspect of the invention a system for conveying rod-like articles pneumatically includes switch means having

1 means defining laterally-spaced passages for articles, means defining a
2 further passage for articles, and operable means for causing relative
3 movement of said means so as to align said further passage with a
4 selected one of said laterally-spaced passages. Preferably the system
5 includes an electrical connection associated with said switch means,
6 wherein said operable means is arranged to cause switching of said
7 electrical connection. In a preferred construction the relative movement
8 is effected by reciprocable means, and may comprise linear and/or
9 rotary components.

10 Where the operable means is rotary, in a preferred construction
11 the system includes a first member having a first face and at least one of
12 said laterally-spaced passages having an outlet in said first face, a
13 second member having a second face and said further passage having
14 an outlet in said second face, means for mounting said first and second
15 members with said first and second faces substantially parallel and
16 adjacent to each other and for relative rotational movement about an axis
17 substantially transverse to said faces, said operable means including
18 means for moving at least one of said members about said axis relative
19 to the other so as selectively to move said member or members between
20 a first position, in which said respective outlets in said first and second
21 faces are in alignment, and a second position, in which said outlets are
22 out of alignment.

23 According to another aspect of the invention a pneumatic
24 conveying system for rod-like articles includes a plurality of delivery
25 devices, a plurality of receiving devices, means defining paths for
26 pneumatic conveyance of articles between each delivery device and at
27 least one receiving device, and further means for conveying articles
28 pneumatically between at least two delivery devices, whereby the supply
29 of articles at one delivery device may be supplemented by receipt of
30 articles from another delivery device. Preferably the system includes
31 switch means for selectively connecting the output from a delivery
32 device either to a receiving device or to another delivery device. In a
33 preferred arrangement the delivery devices are arranged in groups of
34 such devices with each group connected to a different source (e.g. a
35 producing machine such as a filter rod making machine) and said further
36 means comprises means connecting each group. The receiving devices
37 may also be arranged in groups each associated with a different
38 receiving machine (e.g. a processing machine such as a filter cigarette

1 assembling machine). In such an arrangement the receiving devices in
2 each group are preferably connected to delivery devices in different
3 groups.

4 According to a still further aspect of the invention, in a pneumatic
5 filter rod conveying system (which may be in accordance with any other
6 aspect of the invention) the length of a pneumatic conveying path for
7 rod-like articles is determined, and the supply of conveying air is
8 controlled in accordance with said determination. For example the
9 pressure of the conveying air may be automatically adjusted on
10 determination of a changed path length on alteration of switch settings to
11 cause articles to be delivered to a different receiving device.

12 The path length determination may be made by a control system
13 (e.g. including a microprocessor) in accordance with stored information,
14 e.g. relating to locations of one or more switches and path lengths to or
15 from these and the delivery and receiving devices. Alternatively, and in
16 accordance with a further aspect of the invention, the path length
17 determination is carried out by transmitting a sound (possibly comprising
18 or including ultrasound) along the path and determining the path length
19 from receipt of the sound (or an echo or other related signal) after
20 passage along the path.

21 The different aspects of the invention may be embodied in
22 common apparatus.

23 For convenience the invention will be hereinafter described with
24 reference to conveyance of filter rods, hereinafter referred to as "plugs".

25 The invention will be further described, by way of example only,
26 with reference to the accompanying diagrammatic drawings, in which:

27 Figure 1 is a schematic view of a pneumatic plug distribution
28 system,

29 Figure 2 is a perspective view of a switch employed in the system
30 of Figure 1,

31 Figure 3 is a schematic view of a modified plug distribution sys-
32 tem,

33 Figure 4 is a schematic view of a modified version of the system of
34 Figure 3,

35 Figure 5 is a perspective view of a switch employed in the
36 systems of Figures 3 and 4,

37 Figure 6 is an enlarged detail of the switch of Figure 5,

38 Figure 7 is a perspective view of a rotary switch which may be

employed in a pneumatic plug distribution system,

Figure 8 is an end view of the switch of Figure 7, viewed in the direction of arrow A in Figure 7,

Figure 9 is a side view of the switch of Figure 7, viewed in the direction of arrow B in Figure 7, and

Figure 10 is a plan view of a further modified plug distribution system.

Referring to Figure 1, a pneumatic plug distribution system is shown extending between five input tubes 2A-E and three output tubes 4A-C. The tubes are adapted to convey plugs pneumatically. Each of the input tubes 2A-E is connected to a channel 6A-E of a pneumatic distributor. The channels 6A-E are associated with plug making machines 8A-E. Although the channels 6A-E are each shown associated with a different plug making machine 8A-E, two or more channels could be associated with the same machine.

The output tubes 4A-C are connected to receiver channels 10A-C, each of which is associated with a plug assembling machine 12A-C. The channels 10A-C are each shown associated with a different machine 12A-C but two or more could be associated with the same machine. Each of the distributor channels 6A-E and each of the receiver channels 10-C may be of known construction, for example of the type available from the applicants as part of their Pegasus 2000 plug distribution system.

The input tubes 2A-E and output tubes 4A-C are connected by a matrix of further tubes 14 incorporating switches 16, 18 for directing plugs between the tubes. The switches 16 allow passage from one inlet tube to either of two outlet tubes. The switches 18 allow passage from either of two inlet tubes into one outlet tube. The arrangement of tubes 14 and switches 16, 18 is such that, by appropriate selection of settings of switches 16 and 18, any one of the input tubes 2A-E can be connected to provide for passage of plugs to any one of the output tubes 4A-C. In a system similar to that shown in Figure 1 the number of switches necessary is obtained from the expression $2ab - (a + b)$, where a and b are respectively the numbers of inputs and outputs.

One of the switches 16 is shown in Figure 2. An inlet tube 14A is connected to a movable block 20 which is held in abutment with a fixed block 22 by means of a connecting link 24 and retaining springs 26. Two outlet tubes 14B and 14C are connected to the fixed block 22. (On

1 the side of the blocks 20, 22 not visible in the drawing there are two
2 connecting links and a single retaining spring.) The block 20 is attached
3 to a piston rod 28 operated by a double-acting pneumatic cylinder 30
4 attached by way of a trunnion mounting 32 to the fixed block 22 and a
5 fixed frame member 34. In an alternative construction the movable block
6 20 is retained against the underside of fixed block 22 and slides in a
7 substantially straight path between its alternate positions under action of
8 the cylinder 30.

9 In the position shown in Figure 2 the inlet tube 14A is aligned with
10 the outlet tube 14B. By operation of the cylinder 30, the block 20 may
11 be moved so as to align the tube 14A with the outlet tube 14C.
12 Following operation of the cylinder 30, the link 24 and retaining springs
13 26, together with the links and retaining spring on the opposite side of
14 the blocks 20, 22, maintain the block 20 in position so that the tube 14A
15 is aligned with the tube 14B or 14C. It will be understood that each of
16 the blocks 20 and 22 contains bores aligned with the respective tubes
17 14A or 14B and 14C so as to allow free passage of plugs between the
18 tube 14A and 14B or 14C at the switch 16. All of the switches 16 are
19 similar in construction. The switches 18 are also of the same
20 construction, the only difference being the direction of passage of the
21 conveyed plugs.

22 It will be appreciated that typical plug distribution systems provide
23 for electrical communication links between the distributor and receiver
24 channels. For example, the receiver needs to provide a demand signal
25 for use by the distributor and/or to confirm that plugs are being received
26 (e.g. that no blockage has occurred in the tube extending between the
27 respective distributor and receiver channels). The switches 16 and 18
28 may provide not only for switching of the pneumatic lines but also for
29 simultaneous switching of the communication lines. Figure 3 illustrates a
30 system including this feature.

31 The system shown in Figure 3 is similar in construction and operation
32 to that of Figure 1. Four input tubes 102A-D are connected to three
33 output tubes 104A-C by a matrix of tubes 114 including switches 116
34 and 118. The input tubes 102A-D are connected to distributor channels
35 106A-D and plug making machines (not shown), and the output tubes
36 104A-C are connected to receiver channels 108A-C and plug assembling
37 machines (not shown) in the same way as in the system of Figure
38 1.

1 Electrical communication lines 140A-D extend from each distribu-
2 tor channel 106A-D, and similar lines 142A-C extend from each receiver
3 channel 108A-C. These lines are interconnected by a matrix of further
4 communication lines 143 and switches 144 which allow communication
5 between any of the lines 140A-D and any of the lines 142A-C. Each of
6 the lines 140 and 142 may itself comprise multiple wires in parallel for
7 relaying multiple signals between the interconnected respective distribu-
8 tor channel 106 and receiver channel 108. Each pneumatic switch 116,
9 118 has associated with it a pair of electrical switches 144 which are
10 actuated so as to establish electrical connection between the respective
11 distributor channels 106A-D and receiver channels 108A-C which are
12 pneumatically connected. The respective switches 116 or 118 and 144
13 are mechanically ganged so as to ensure that the electrical and pneu-
14 matic connections are always consistent.

15 The switch 116 shown in Figures 5 and 6 connects an inlet tube
16 114A to either one of two outlet tubes 114B and 114C. The construction
17 of the switch 116 is similar to that of the switch 16 of Figure 2 and it
18 incorporates a movable block 120 and fixed block 122. However, in
19 addition, an electrical switch 144 is attached to the fixed block 122. The
20 movable block 120 carries an arm 121 which, in the position shown in
21 Figure 5 where the tube 114A is aligned with the tube 114C, actuates a
22 switch lever 146 so as to close (or open) contacts 148 (Figure 6) and
23 establish a connection between electrical lines associated with the tubes
24 114A and 114C. Thus, the switches 116 and 144 shown in Figure 5 may
25 be those marked 116' and 144' in Figure 3, the switches establishing
26 connections between the inlet tube 102D leading from the distributor
27 channel 106D and respective tubes and lines leading to one of the
28 receiver channels 108A-C. In the configuration illustrated the
29 connections are to the receiver channel 108B.

30 As the pairs of switches 144 associated with a pneumatic switch
31 116 or 118 as shown in Figure 3 are always switched together, i.e. one is
32 always open when the other is closed and vice versa, the switch 144 of
33 Figure 5 can (with appropriate contacts) perform the function of both
34 switches 144' shown in Figure 3. Alternatively, an additional switch 144
35 (not shown) could be connected to the underside of the fixed block 122
36 as shown in Figure 5 so that movement of the block 120 physically
37 makes the connection for the communication line associated with the
38 tube 114B as well as for the tube 114C. In either case, movement of the

1 block 120 to its alternate position, with the tube 114A aligned with the
2 tube 114B, disconnects the electrical connection to the line associated
3 with the tube 114C and makes the connection to the line associated with
4 the tube 114B.

5 An electrical switch 144 may be provided in conjunction with a
6 pneumatic switch 118 in exactly the same way as with a switch 116.

7 An electrical switch 144 associated with a pneumatic switch 116
8 or 118 has the additional benefit of being able to signal that the pneu-
9 matic switch has physically reached its desired operating position follow-
10 ing a change. Of course the electrical communication lines leading to a
11 electrical switch 144 associated with a pneumatic switch 116 or 118 may
12 also conveniently include those carrying the signals for actuating the
13 pneumatic switch (although such signal lines would not normally be
14 switched by a switch 144).

15 It will be appreciated that electrical communication between a
16 distributor channel 106A-D and a receiver channel 108A-C in the system
17 of Figure 3 involves many switch contacts, failure of any of which may
18 cause a system malfunction. A modified system, in which there are
19 fewer electrical switches, is shown in Figure 4, in which reference
20 numbers similar to those used in Figure 3 have been used for similar
21 parts. In the system of Figure 4 the lines 140A-D and 142A-C are exten-
22 ded to form a matrix and are interconnectable by switches 144 placed at
23 the intersections. Each of the switches 144 is physically ganged with the
24 pneumatic switch 116 or 118 which is nearest to it (as viewed in Figure
25 4). In this respect note that the switches 116 and 118 which are
26 associated with crossover intersections, e.g. those connected by a
27 curved section of tube 143A, must always be switched together as a
28 pair. It follows that the associated electrical switch 144 could be
29 mounted on either of these paired switches.

30 Switches 144 may not be located so as to physically interrupt a
31 line extending between a distributor channel and a receiver channel. For
32 example, a switch 144 may be provided in a signal line associated with a
33 control unit, e.g. including a microprocessor, so that the control unit
34 responds to the status of the switch and itself establishes the appropriate
35 communication link.

36 Any (or all) of the switches 16, 18, 116 or 118 may be replaced by
37 a rotary switch similar to the switch 216 shown in Figures 7 to 9. The
38 rotary switch 216 connects an inlet tube 214A to either one of two outlet

1 tubes 214B and 214C. The tubes 214A, 214B, 214C correspond
2 respectively to tubes 14A, 14B, 14C and 114A, 114B, 114C and may
3 form part of a matrix of tubes similar to those described with reference to
4 the tubes 14 and 114. The outlet tubes 214B, 214C are attached by way
5 of suitable connectors to one face of a stationary plate 222 which
6 contains bores in alignment with the outlet tubes and passing through
7 the plate to an opposite parallel face. A movable plate 220 is arranged
8 with a corresponding parallel face arranged immediately adjacent said
9 opposite face of plate 222. A rotary actuator 230 arranged on the same
10 side of the plate 222 as the tubes 214B, 214C has an actuating shaft 231
11 which passes rotatably through a bore in the plate 222 and is fixed to the
12 movable plate at 233.

13 The inlet tube 214A is attached to the movable plate 220 by a
14 suitable connector and is aligned with a bore which passes through the
15 plate. The bore in the plate 220 and the bores in the plate 222 are
16 arranged equidistantly from the axis defined by the shaft 231. At least the
17 bore in the movable plate 220 is provided with resilient sealing means in
18 the form of an O-ring 235 carried in a groove around its perimeter at its
19 end adjacent the plate 222, so as to provide a pneumatic seal between
20 bores in plates 220 and 222 when these are in alignment. The plate 222
21 carries electrical proximity switches 244.

22 In operation, the rotary actuator 230, which is of double acting
23 type, may be operated to reciprocally pivot the member 220 between
24 the position shown in the drawings, in which tubes 214A and 214C are
25 aligned, and a position which is rotated through about 45° in a clockwise
26 direction as viewed in Figure 8, in which tubes 214A and 214B are
27 aligned. The inlet tube 214A may be manufactured from relatively flexible
28 material, e.g. plastics material, to allow movement of its end connected
29 to plate 220 with its opposite end (not shown) fixed. Any of the tubes 14A
30 or 114A may be similarly manufactured.

31 The electrical switches 244, which may be proximity switches
32 arranged to detect one or more features of or carried by the plate 220,
33 may perform any of the functions of the switches 144. Alternatively these
34 switches may be supplemented by contact switches (not shown) to
35 perform at least some of these functions.

36 As described, the switch 216 is located between an inlet tube
37 214A and two outlet tubes 214B, 214C: the switch is equally well-suited
38 for use when the tubes 214B, 214C are inlet tubes and the tube 214A is

1 an outlet tube. In this latter case, it is preferred that the movable plate
2 220 is provided with through bores located on each side of the tube
3 214A such that when tube 214A is aligned with tube 214B tube 214C is
4 aligned with one of the bores and when tube 214A is aligned with tube
5 214C tube 214B is aligned with the other of said bores. With this
6 arrangement, if plugs are conveyed down the inlet tube not aligned with
7 the outlet tube 214A (usually because of a fault) those plugs exit through
8 the respective bore in plate 220 instead of backing up in the inlet tube
9 and possibly causing a line jam.

10 Mechanical switching of an appropriate communication link simul-
11 taneously with switching of the pneumatic tubes ensures that correctly-
12 controlled transport of plugs occurs between the required distributor and
13 receiver channels following a change of routing. A control system may
14 manage the input and output configurations for the pneumatic tubes
15 from continually monitored information gathered from the equipment
16 linked by the system. Typically this equipment includes one or more plug
17 making machines each associated with a plug reservoir (e.g. Molins
18 Polar), a multi-channelled distributor associated with each plug making
19 machine/plug reservoir, one or more plug assembling machines, and
20 single or multi-channelled receivers at each plug assembling machine. In
21 such a system the information processed by the control system for each
22 item of equipment, and on the basis of which the control system will
23 make subsequent switches of connections, is as follows:

| | | |
|----|----------------------|--------------------------|
| 24 | | |
| 25 | Plug Making Machine: | Address (I.D.) |
| 26 | | Plug type |
| 27 | | Plug rate |
| 28 | | Status (on/off) |
| 29 | | |
| 30 | Plug Reservoir: | Address (I.D.) |
| 31 | | Plug type |
| 32 | | Fill level |
| 33 | | Status (on/off) |
| 34 | | Plug Making Machine I.D. |
| 35 | | |
| 36 | | |
| 37 | | |
| 38 | | |

| | | |
|----|-----------------|-----------------------|
| 1 | Distributor: | Channel I.D. |
| 2 | | Plug type |
| 3 | | Plug rate |
| 4 | | Status (on/off) |
| 5 | | Plug Reservoir I.D. |
| 6 | | Tube No. |
| 7 | | Tube length |
| 8 | | |
| 9 | Receiver: | Channel I.D. |
| 10 | | Plug type |
| 11 | | Minimum rate required |
| 12 | | Tube No. |
| 13 | | Tube length |
| 14 | | Status (run/idle) |
| 15 | | Demand (on/off) |
| 16 | | |
| 17 | Plug Assembling | |
| 18 | Machine: | Address (I.D) |
| 19 | | Plug type |
| 20 | | Usage rate |

21
22 The control system may provide other functions. For example,
23 pneumatic plug distribution systems are sensitive to line air pressure, i.e.
24 a long tube run may require a higher line air pressure. The system may
25 be arranged to calculate the new distance between the distributor and
26 receiver following a changed connection, so as to automatically reset the
27 line pressure to a value appropriate to the distance. The pressure can
28 be set by an electronically controlled regulator at the distributor. The
29 distance may be calculated from information provided to the system
30 relating to locations of the switches and tube lengths between the
31 switches.

32 In combination with the distance determination, or separately, the
33 system may allow checking that the correct configuration has been
34 achieved following a switched connection. Thus, a single plug could be
35 sent and its arrival at the receiver recorded. If the distance to the receiv-
36 er is known, the system may determine the average velocity of the plug
37 and readjust the line pressure to compensate for any anomalies. The
38 single plug transmitted may be released through an exit gate at the

1 receiver, e.g. as disclosed in British Patent Specification No. 2272414.

2 As a supplement or alternative to distance determination based on
3 input information, a sound pulse could be transmitted down the tube and
4 recorded at the receiver. The transmission time could be used to deter-
5 mine the tube length. A similar system could also feed back information
6 of a blockage in the tube. By detection of an echo it may be possible to
7 determine the location of a blockage. Alternatively, or additionally, a
8 rough estimate can be obtained by switching a connection and testing
9 the new tube path, either with sound or a test plug: this can determine
10 whether a blockage is before or after a switch location. Indication of a
11 blockage may also be provided by one or more strategically positioned
12 flow or pressure detectors along the tube lengths.

13 Information relating to input and output product changes can be
14 sent to a PC or other programmable processor to record exactly what
15 product was delivered to each plug assembling machine during speci-
16 fied periods. This feature allows tracking of batches of products.

17 The system of Figure 1 could incorporate the communication links
18 and control system described with reference to any of Figures 3-5.

19 In the system shown in Figure 6 three pneumatic distributor units
20 C1, C2, C3, each having five channels S, D1, D2, D3 and D4, are linked
21 by pneumatic tubes 60 to six plug assembling machines P1-P6, each of
22 which has receiver units having two channels. The distributor units C1-
23 C3 are each connected to a plug making machine (not shown). The
24 pneumatic tubes 60 leading to the respective machines P1-P6 are shown
25 only for machine P1. The receiver channels in each of the machines P1-
26 P6 are connected to distributor channels in different units. Thus, in the
27 event of a malfunction of one of the units C1-C3 (or of its associated plug
28 making machine) each of the machines P1-P6 should continue to re-
29 ceive plugs through at least one of the tubes 60 connected to it.

The connections between the distributor channels and the machines P1-P6 are as follows:

| <u>Machine</u> | <u>Channel 1 connection</u> | <u>Channel 2 connection</u> |
|----------------|-----------------------------|-----------------------------|
| P1 | C1D1 | C2D1 |
| P2 | C1D2 | C2D2 |
| P3 | C1D3 | C3D1 |
| P4 | C2D3 | C3D2 |
| P5 | C1D4 | C3D3 |
| P6 | C2D4 | C3D4 |

In this table C1D1 designates distributor channel D1 in unit C1 etc.

Each of the units C1-C3 consists of a hopper which receives plugs from the associated plug making machine and supplies them to the five distributor channels of the unit. The units may be Molins Pegasus distributor units. Separate two-channel receiver units R1-R3 are respectively connected to the units C1-C3 so that plugs received by the receiver units are delivered to the hopper of the respective unit C1, C2 or C3. The receiver units R1-R3 may be Molins Pegasus receiver units (and may be identical to the receiver units incorporated in the machines P1-P6).

The distributor channel S in the unit C1 is a spare, and is not connected to any tube extending directly to one of the machines P1-P6. It is connected to an input tube 62A of a switch 64A having three output tubes 66A, 68A and 70A. The switch 64A is of generally similar construction to the switches 16 and 116 of Figures 2 and 5 or switch 216 of Figure 7 except that it has three operative positions. The tubes 66A and 68A are respectively connected to one of the receiver channels of the receiver units R2 and R3 associated with the other distributor units C2 and C3. The tube 70A is connected to one channel of a triple receiver unit 72 (which, again, may be a Molins Pegasus unit) connected to feed plugs to a tray filling machine 74. The spare channels S of the units C2 and C3 are connected by way of respective units 62B and 62C, switches 64B and 64C, and further tubes 66B, 68B, 70B, and 66C, 68C, 70C, in a manner which is analogous to the connections for the unit C1.

The system of Figure 10 allows spare capacity from a plug making machine associated with any of the units C1, C2 or C3 to be directed to

1 supplement the supply at any of the other units. In addition, spare
2 capacity may be directed to the tray filler 74, for onward conveyance of
3 plugs in trays to another distributor unit or plug assembler. Because of
4 the links between the units C1, C2 and C3, the plugs being delivered to
5 these units (i.e. from the plug making machines) must be of the same
6 type. By contrast, in the systems of Figures 1, 3 and 4 different types of
7 plug may be conveyed, as long as they are physically compatible with
8 the tubes and it is ensured that a receiver receives only the correct
9 product for its associated plug assembling machine. It follows that
10 where different types of plug are transported in systems such as that
11 depicted in Figures 1, 3 or 4 certain switch connections must be barred
12 (so as to ensure no mixing of plug types).

13 The system of Figure 10 may incorporate appropriate
14 communication connections which are switched by the switches 64A,
15 64B and 64C in the same way as described with reference to the
16 systems of Figures 3-5.

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Claims

1. A pneumatic conveying system for rod-like articles, comprising at least one delivery device, at least one receiving device, means defining a pneumatic delivery path extending from said delivery device, means defining a pneumatic receiving path extending towards said receiving device, first switch means for selectively establishing connection between said delivery path and said receiving path, means for establishing communication between said delivery device and said receiving device including second switch means for selectively enabling signal communication in accordance with the status of said first switch means, and means for switching said first and second switch means.

2. A system as claimed in claim 1, wherein said first and second switch means include a common switching element.

3. A system as claimed in claim 1 or 2, wherein said second switch means is associated with electrical communication lines extending between said delivery device and said receiving device.

4. A system as claimed in claim 3, wherein said electrical communication lines include processing means.

5. A system as claimed in any preceding claim, including control means for actuating said switching means in accordance with signals derived in dependence on occupation or passage of articles in the system.

6. A system as claimed in any preceding claim, including at least one further pneumatic path, said first switch means being arranged to selectively establish connection between said further pneumatic path and one of said delivery path and receiving path.

7. A system as claimed in claim 6, wherein said second switch means is arranged to selectively enable communication with a delivery or receiving device associated with said further path.

8. A system as claimed in any preceding claim, including a

1 plurality of delivery devices and a plurality of receiving devices, a
2 plurality of pneumatic delivery paths extending from said delivery
3 devices and a plurality of receiving paths extending towards said
4 receiving devices, and a plurality of junctions between said delivery and
5 receiving paths including first and second switch means associated with
6 said junctions, and means for operating respective first and second
7 switch means to establish pneumatic and electrical communication
8 between selected delivery and receiving devices.
9

10 9. A system as claimed in any preceding claim, including
11 upstream and downstream first switch means arranged in series and
12 associated respectively with first and second pneumatic junctions,
13 including a common second switch means associated with said
14 respective first switch means.
15

16 10. A system as claimed in claim 9, wherein said first
17 pneumatic junction includes an input path and at least two output paths,
18 and said second junction includes at least two input paths, one of which
19 corresponds to one of said output paths from said first junction, and an
20 output path.
21

22 11. A pneumatic conveying system for rod-like articles,
23 comprising switch means having means defining laterally-spaced
24 passages for articles, means defining a further passage for articles, and
25 operable means for causing relative movement of said means so as to
26 align said further passage with a selected one of said laterally-spaced
27 passages.
28

29 12. A system as claimed in claim 11, including an electrical
30 connection associated with said switch means, wherein said operable
31 means is arranged to cause switching of said electrical connection.
32

33 13. A system as claimed in claim 11 or 12, wherein said
34 operable means comprises reciprocable means operable between
35 defined positions corresponding to alignment of said third passage with
36 either said first or said second passage.
37

38 14. A system as claimed in any of claims 11-13, including

1 conduit means connected to at least one of said passages, said conduit
2 means being laterally flexible to accommodate movement caused by
3 said operable means.

4
5 15. A system as claimed in any of claims 11-14, wherein said
6 means defining a third passage is formed in a reciprocable body
7 constrained to move between positions in sealing engagement with said
8 first and second passages.

9
10 16. A system as claimed in any of claims 11-15, wherein said
11 operable means comprises rotary means.

12
13 17. A system as claimed in claim 16, including a first member
14 having a first face and at least one of said laterally-spaced passages
15 having an outlet in said first face, a second member having a second
16 face and said further passage having an outlet in said second face,
17 means for mounting said first and second members with said first and
18 second faces substantially parallel and adjacent to each other and for
19 relative rotational movement about an axis substantially transverse to
20 said faces, said operable means including means for moving at least one
21 of said members about said axis relative to the other so as selectively to
22 move said member or members between a first position, in which said
23 respective outlets in said first and second faces are in alignment, and a
24 second position, in which said outlets are out of alignment.

25
26 18. A system as claimed in claim 17, wherein said
27 laterally-spaced passages comprise said outlet in said first face and a
28 further outlet in said first face.

29
30 19. A system as claimed in claim 18, wherein said further outlet
31 and said outlet in said second face are in alignment when said members
32 are in said second position.

33
34 20. A system as claimed in claim 19, wherein said outlets and
35 said further outlet are substantially equidistant from said axis.

36
37 21. A system as claimed in any of claims 17-20, wherein at
38 least one of said faces carries sealing means arranged to provide a seal

1 around the transition between outlets which are in alignment.

2
3 22. A system as claimed in any of claims 1-9, wherein said first
4 switch means includes a system as claimed in any of claims 10-21.

5
6 23. A pneumatic conveying system for rod-like articles,
7 including a plurality of delivery devices, a plurality of receiving devices,
8 means defining paths for pneumatic conveyance of articles between
9 each delivery device and at least one receiving device, and further
10 means for conveying articles pneumatically between at least two delivery
11 devices, whereby the supply of articles at one delivery device may be
12 supplemented by receipt of articles from another delivery device.

13
14 24. A system as claimed in claim 23, further including switch
15 means for selectively connecting the output from a delivery device either
16 to a receiving device or to another delivery device.

17
18 25. A system as claimed in claim 24, wherein the switch means
19 includes a system as claimed in any of claims 10-21.

20
21 26. A system as claimed in claim 24 or 25, wherein the switch
22 means is connectable to a receiving device which loads articles into
23 containers.

24
25 27. A system as claimed in any of claims 23-26, including at
26 least two groups of delivery devices, with each group connected to a
27 different source of articles.

28
29 28. A system as claimed in any of claims 23-27, including at
30 least two groups of receiving devices, with each group associated with a
31 different machine for processing articles received from said receiving
32 devices.

33
34 29. A system as claimed in claim 28 when dependent on claim
35 27, wherein the receiving devices in each group are connected to
36 delivery devices in different groups.

37
38 30. A system as claimed in any preceding claim, including

1 means for determining the length of a pneumatic conveying path in the
2 system and controlling the supply of conveying air in accordance with
3 said determination.

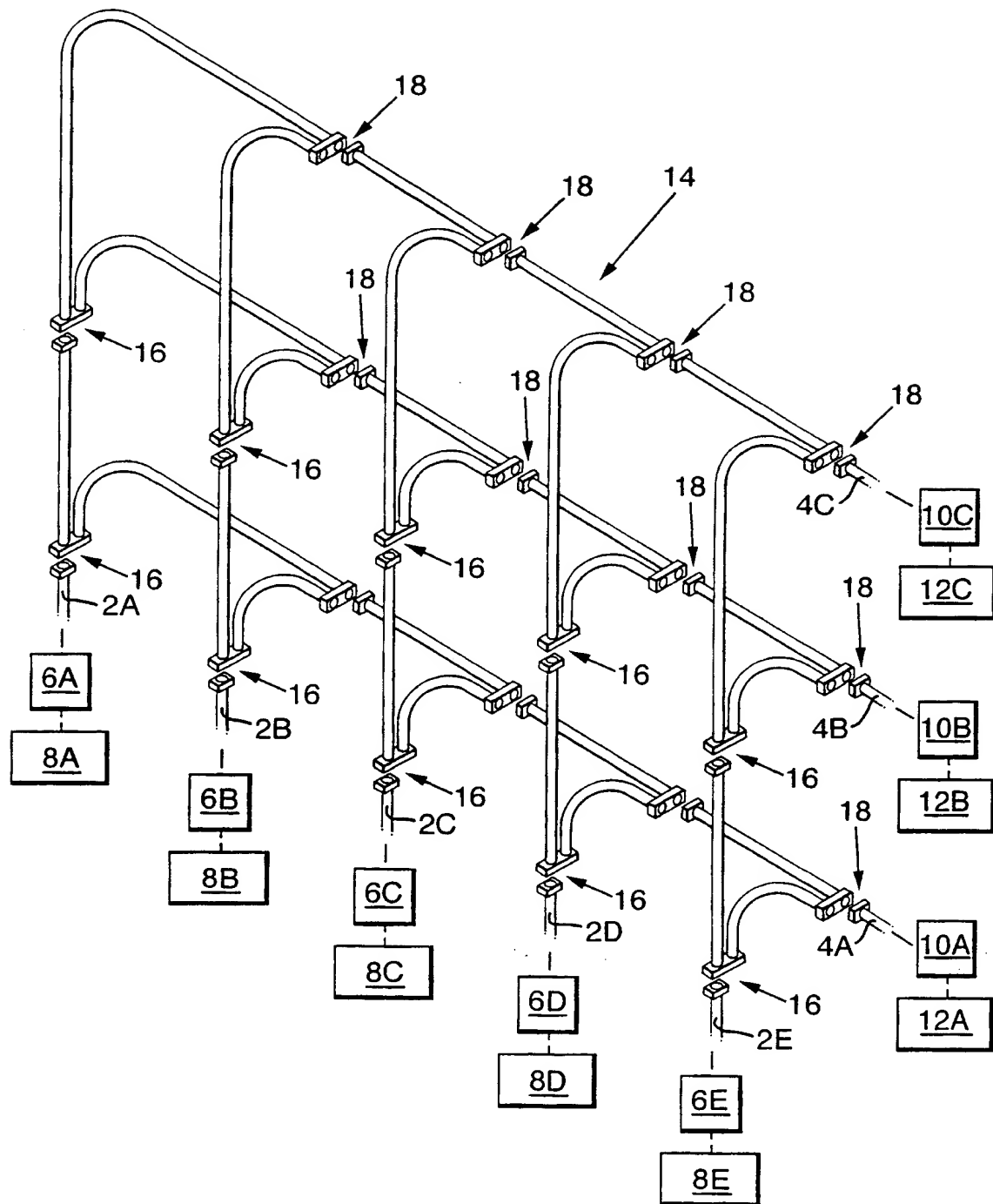
4
5 31. A system as claimed in claim 30, including means for
6 adjusting the pressure of conveying air on determination of a path length
7 change for articles.

8
9 32. A system as claimed in claim 30 or 31, further including
10 control means for determining passage of articles in the system, said
11 control means including means for storing parameters associated with
12 the system, wherein the path length determination is made in
13 accordance with information stored by said storing means.

14
15 33. A system as claimed in any of claims 30-32, wherein the
16 path length determination is carried out by transmitting a sound along
17 the path and determining the path length from receipt of the sound (or
18 an echo or other related signal) after passage along the path.

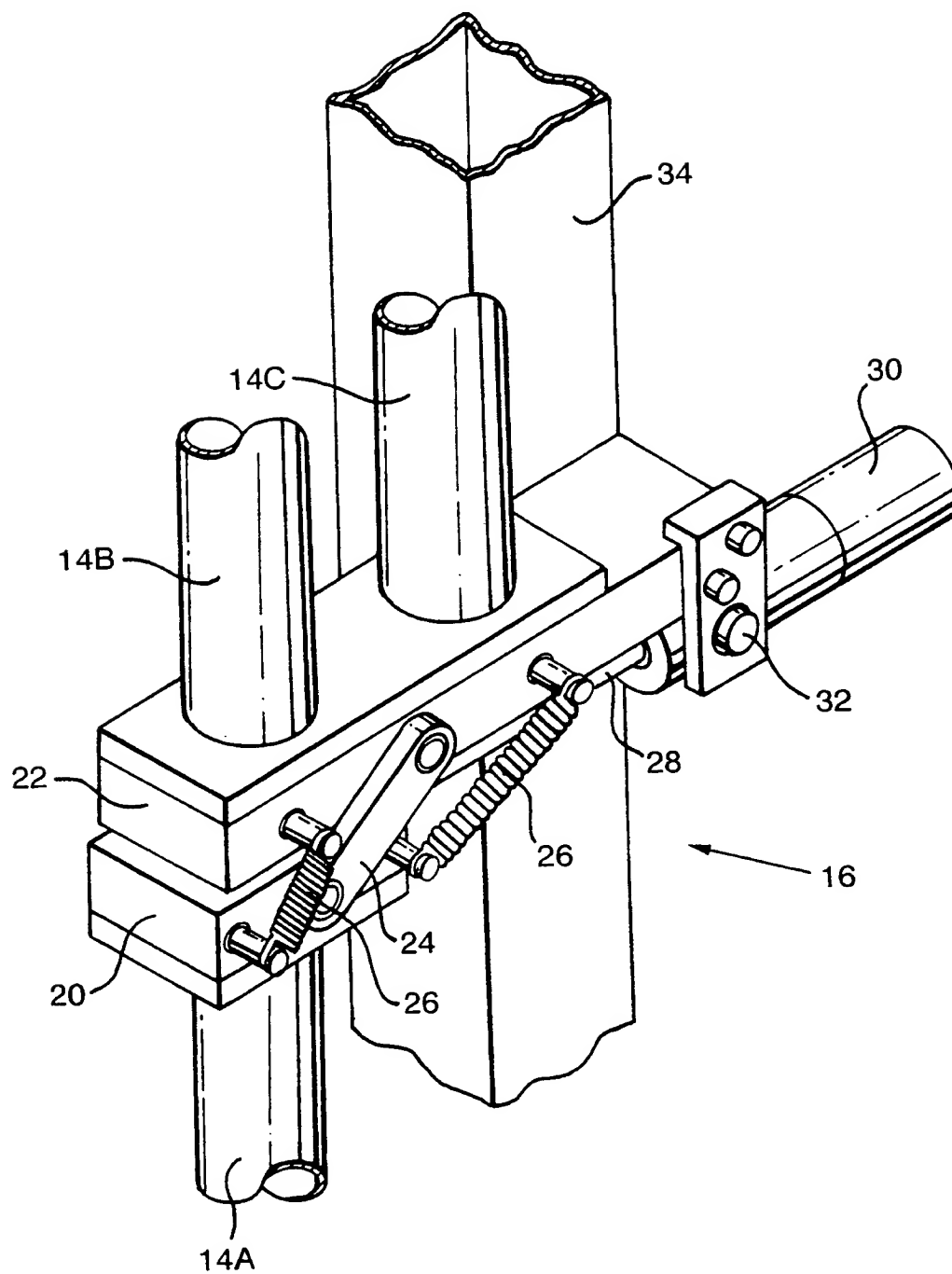
19
20 34. A method of determining a path length for rod-like articles
21 in a pneumatic conveying system, including the step of transmitting a
22 sound along the path and determining the path length from receipt of the
23 sound (or an echo or other related signal) after passage along the path.
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Fig.1.



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Fig.2.



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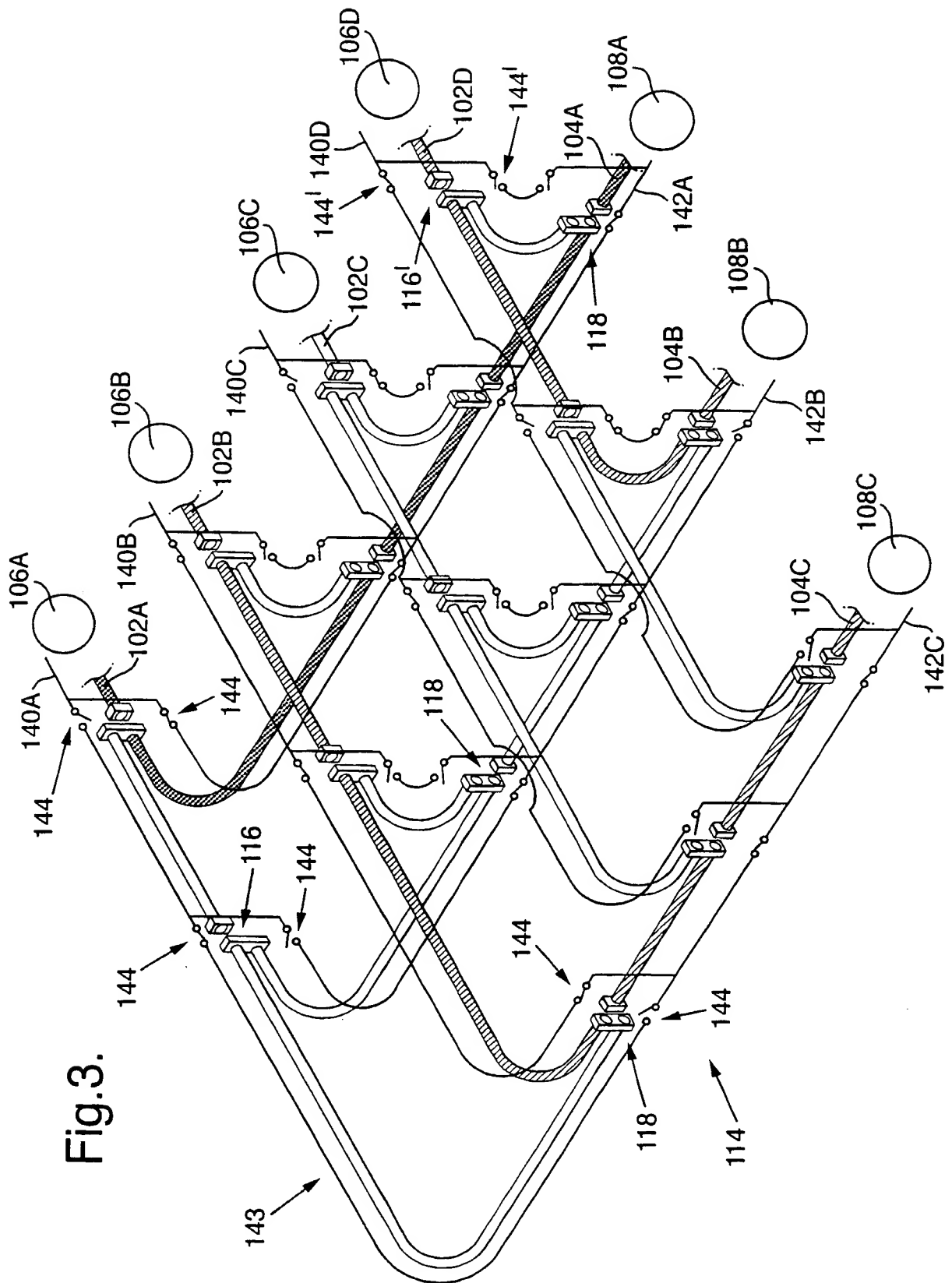


Fig.3.

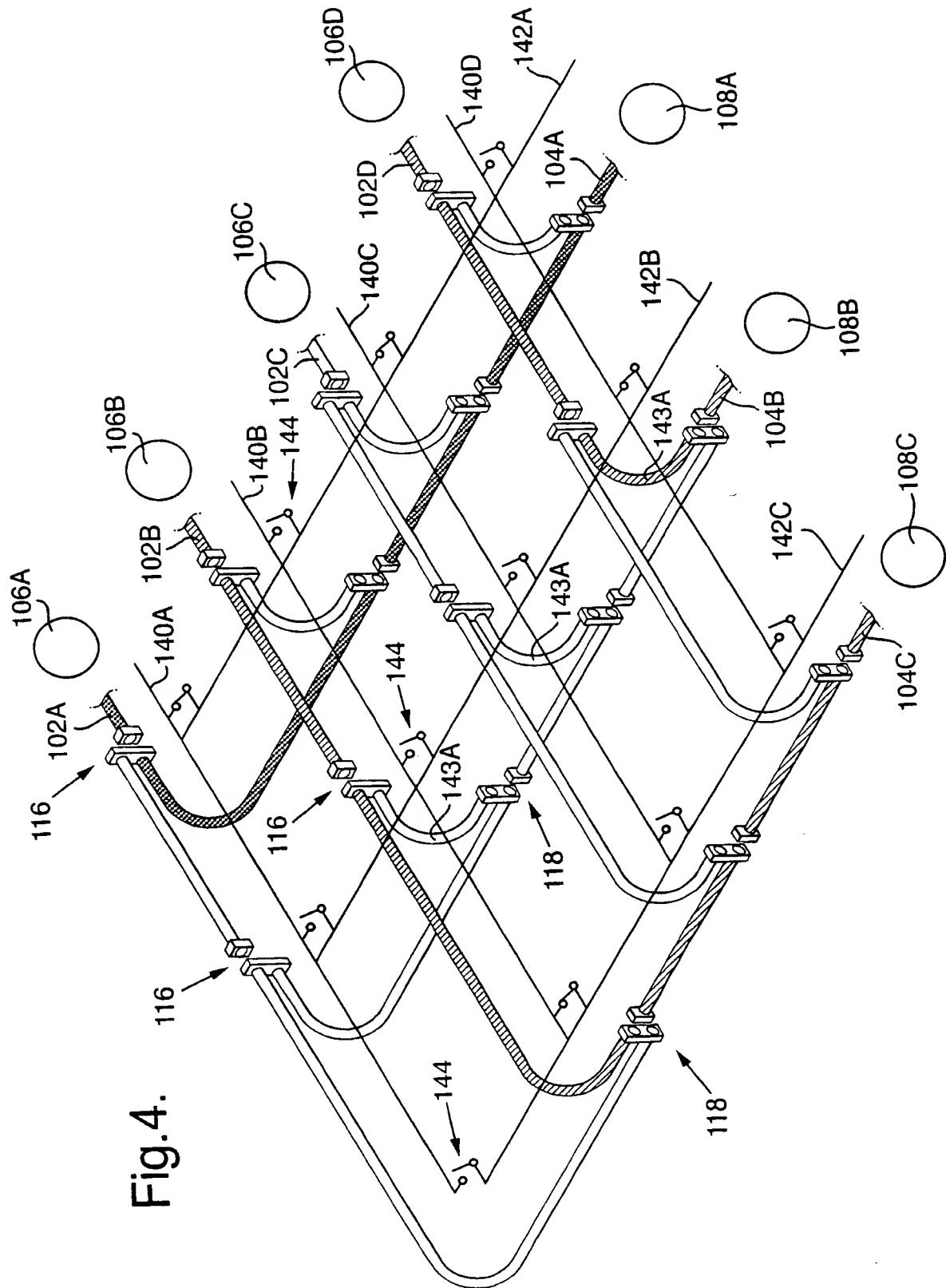


Fig. 4.

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Fig.5.

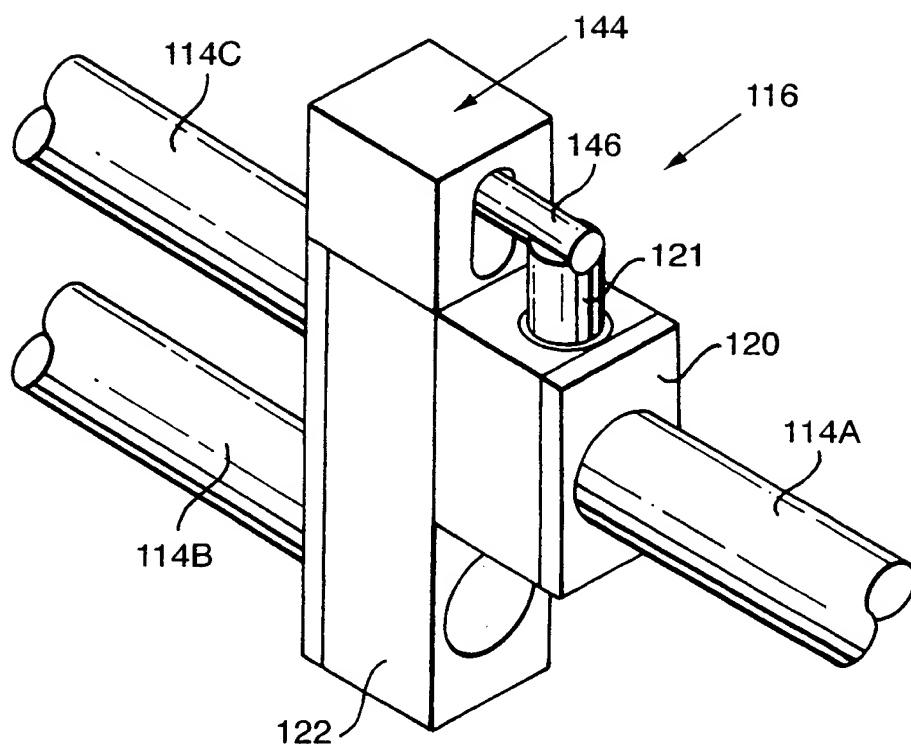
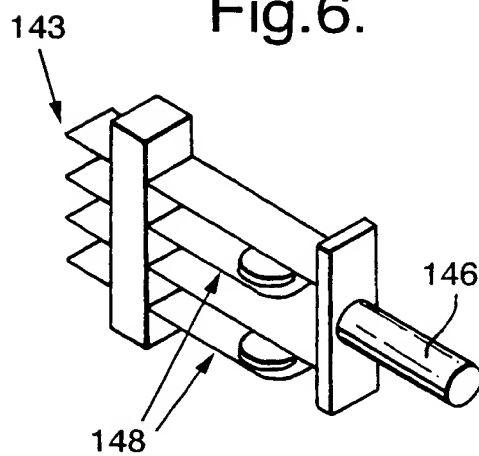


Fig.6.



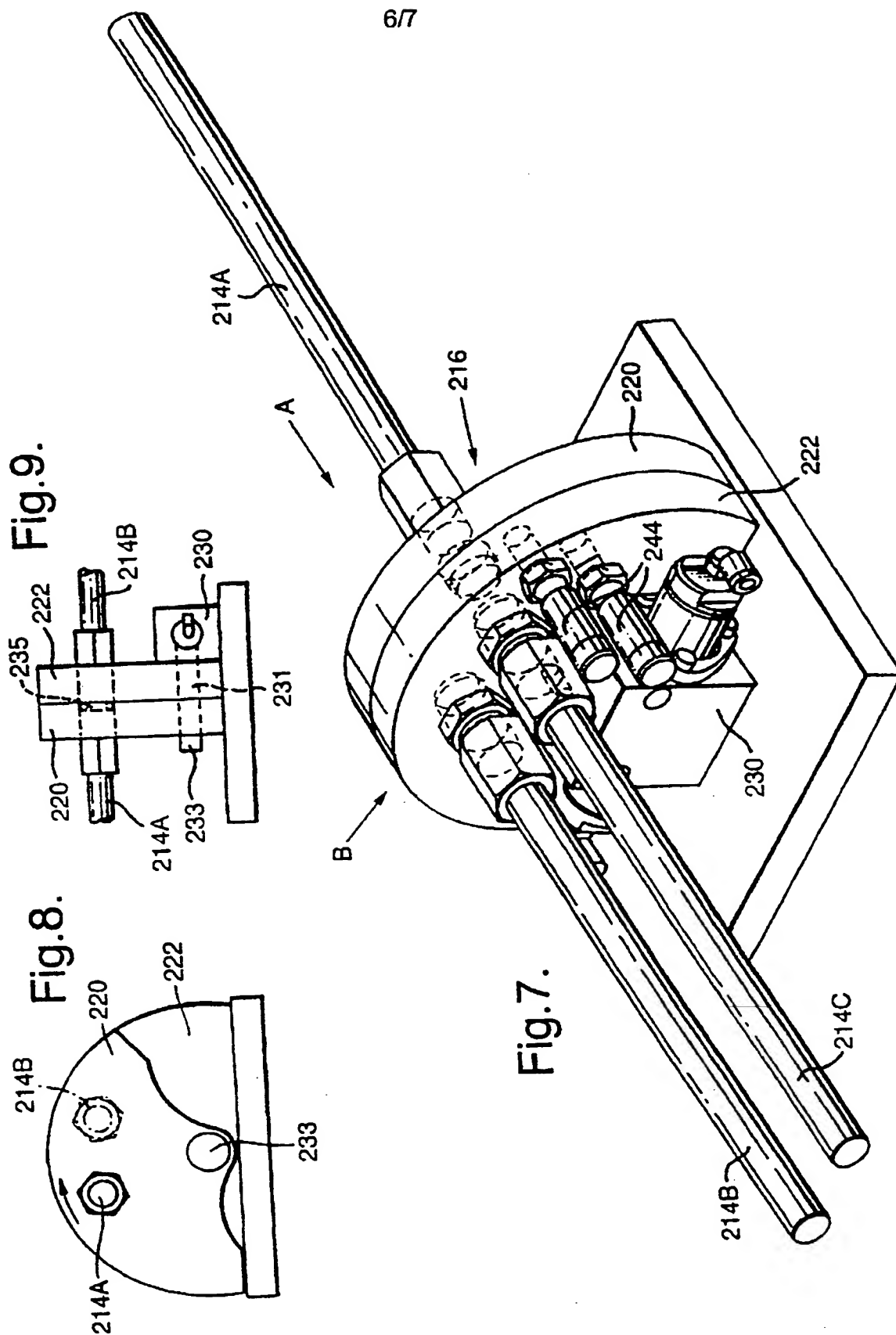
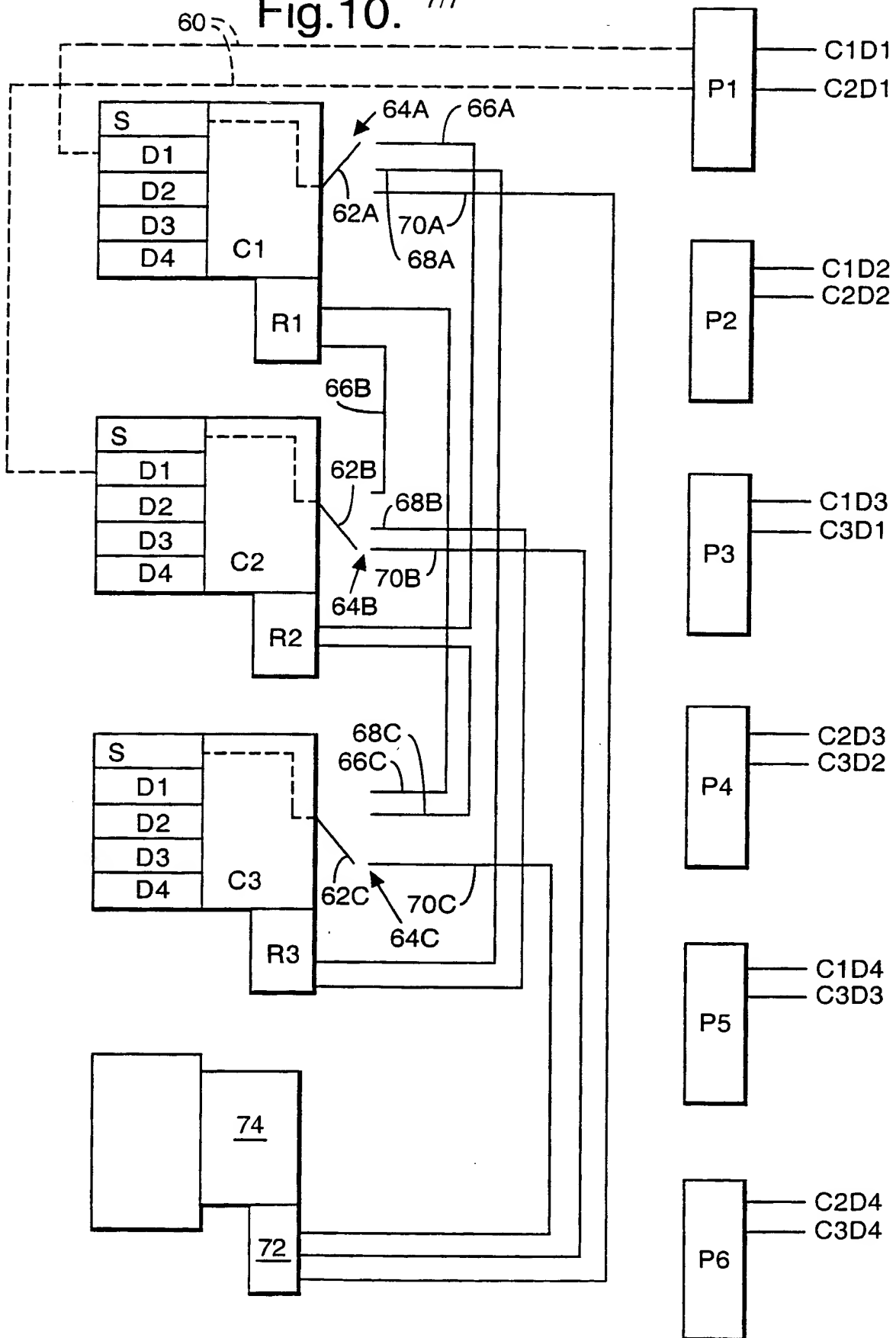


Fig.10. 7/7



INTERNATIONAL SEARCH REPORT

International Application No

PCT/GB 98/03276

A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 A24C5/32

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 6 A24C B65G

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

| Category * | Citation of document, with indication, where appropriate, of the relevant passages | Relevant to claim No. |
|------------|---|-----------------------|
| X | US 4 595 025 A (WAHLE) 17 June 1986 see column 28, line 31 - column 32, line 65; figures 8A-13 | 11-16 |
| A | --- | 1, 5, 6, 8, 23 |
| A | WO 97 16365 A (FABRIQUES DE TABAC REUNIES S.A.) 9 May 1997 see the whole document | 1, 8-11, 23, 24 |
| A | --- | 34 |
| | WO 89 01130 A (BODE) 9 February 1989 see abstract | |
| | ----- | |

☐ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

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Date of the actual completion of the international search

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Date of mailing of the international search report

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Name and mailing address of the ISA
European Patent Office, P.B. 5818 Patentlaan 2
NL - 2280 HV Rijswijk
Tel. (+31-70) 340-2040, Tx. 31 651 epo nl,
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INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No

PCT/GB 98/03276

| Patent document cited in search report | Publication date | Patent family member(s) | Publication date |
|---|---------------------|----------------------------|---------------------|
| US 4595025 A | 17-06-1986 | DE 3335955 A | 26-04-1984 |
| | | GB 2132871 A,B | 18-07-1984 |
| | | JP 59098674 A | 07-06-1984 |
| WO 9716365 A | 09-05-1997 | CN 1201433 A | 09-12-1998 |
| | | EP 0865396 A | 23-09-1998 |
| WO 8901130 A | 09-02-1989 | AU 2315988 A | 01-03-1989 |

